

Middle East Lepidoptera, XXXII:

Diagnosis of some eremic tribes of Noctuidae—Quadrifinae, with a discussion of their biogeographical significance¹

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(With a text-figure)

The Old World North-tropical desert zone is considered in relation to the Noctuid genus-groups which characterise it. A definition of Eremic as applying to genus-groups is given. A survey is made of Noctuidae-Quadrifinae tribes already diagnosed and published, which are found inadequate. Proposals and diagnoses are made for further tribal divisions in the Eremic *Catocalinae* (sensu lato) with details of distribution. What is known of the biological data of these groups is discussed and conclusions from these and from their distribution are suggested regarding the history of the desert zone and the Eremic *Catocalinae*.

INTRODUCTION

Deserts are characterised by conditions comparatively inimical to life; insects characteristic of adjacent mesophilous areas are less able to inhabit deserts the further they penetrate. In true desert therefore are found:

- (i) temporary immigrants from adjacent areas,
- (ii) species characteristic of adjacent areas, resident only in enclaves with un-typical micro-climates, e.g. oases; and
- (iii) specialised resident forms.

It would require too much space to discuss here what morphological characters might be considered adaptations to desert conditions; the desert specialists here discussed are recognised as such from their distribution.

The term Eremic is here used with reference to the Old World North Tropical desert zone, which is virtually continuous from west to east, considerably overlapping the Tropic of Cancer in Africa, and reaching the latitude of 50° N in Eastern Asia (see Fig. 1).

TAXONOMIC RELATIONS OF EREMIC LEPIDOPTERA

Some genera (e.g. the Noctuid-Trifid *Agrotis* Ochs. 1816) contain a minority of species specialised to Eremic conditions; other genera (e.g. the Noctuid-Trifid *Oligia* Hubner 1821) contain none at all; these two types of genus are here termed "Non-Eremic". But others again are mainly or entirely composed of specialised Eremic residents, and these are here termed "Eremic" genera. These terms can similarly apply to higher taxa, e.g. tribes, sub-families, families. While there is no Eremic Noctuid subfamily, there are several Eremic tribes;

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but the incompleteness of the tribal system of the Noctuidae-Quadrifinae obscures the fact. The tribe is the taxon intermediate between subfamily and genus authorised by Recommendation 29A of the International Code of Zoological Nomenclature. This article therefore seeks to complete the tribal system of the Noctuidae-Quadrifinae, at least as regards the

mainly composed of Eremic specialists one might deduce that the deserts which they inhabit are not ancient; but if there are such genera, and a *fortiori* if there are tribes so composed, great antiquity may be inferred.

(E) following a genus or tribe in the tables or text of this article signifies that it is Eremic; (NE) signifies that it is Non-Eremic. [] Bra-

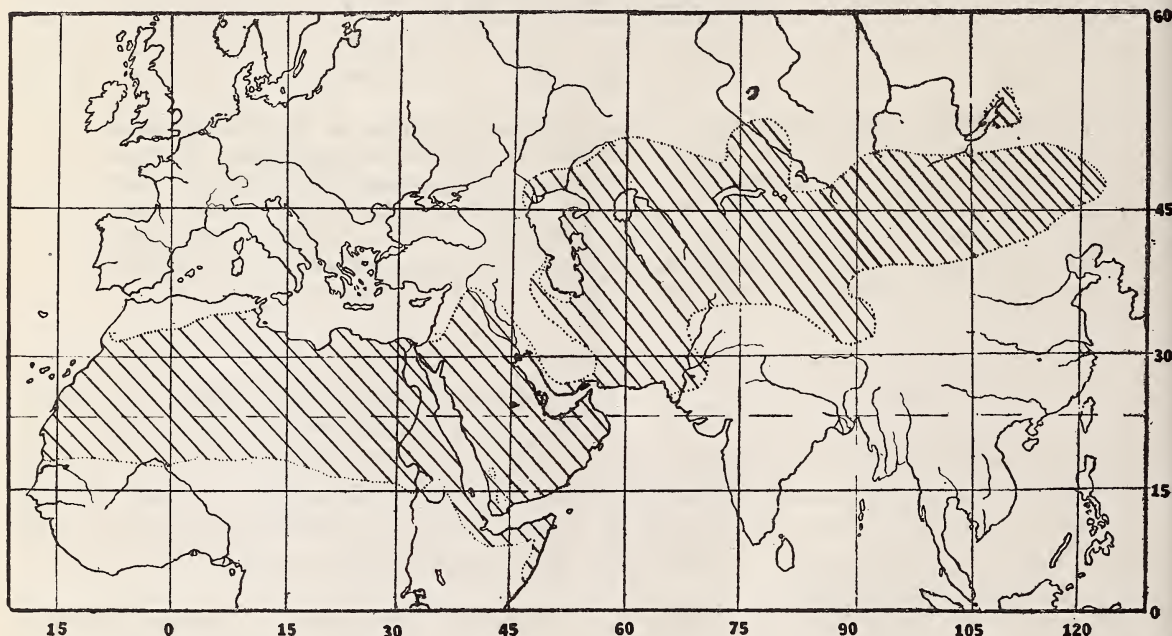


Fig. 1. The Old World North-Tropical Desert Zone: the shaded area is bounded by the 300 mm (11.8") isohyet.

Catocalinae sensu lato (*Catocalinae* and *Othereinae sensu auctorum*). As the existing subfamily system has been considerably criticised (see Berio, 1959 and Birch, 1972), this attempt may contribute to the clarification of suprageneric Noctuid relationships; it may also have biogeographical significance. The higher the rank of taxa sharing the same ecological speciality in an ecofauna, the longer is the associated history which one may attribute to the habitat and its inhabitants. If no genus were

ckets are used to indicate a more up-to-date name which it is suggested might be used for a name used by the author of a name of a tribe or sub-family.

Survey of tribes

A system down to tribe and genus not only for the *Noctuidae* but for the whole *Lepidoptera* was proposed by C. Börner, 1939 & 1944, based particularly on characters of tongue, tympanum, etc. It was however based on a local fauna composed of Non-Eremic genera;

TABLE 1

NOCTUID QUADRIFID TRIBES AS IN BÖRNER'S SYSTEM
(Showing genera named by Börner found in Eremic Zone)

HYPENINAE	
Rivulini	(NE) <i>Rivula</i> Guenee
Hypenini	(NE) <i>Hypena</i> Schranck
HYLOPHILINAE [NYCTEOLINAE]	
Sarrothripini [Nycteolini]	
Hylophilini [Benini]	(NE) <i>Earias</i> Hübner
CATOCALINAE	
Catocalini	
Toxocampini [Lygephilini]	(NE) <i>Autophila</i> Hübner
Cocytini [Anuini]	(NE) <i>Ophiusa</i> Ochs.
SCOLIOPTERYGINAE	
Scoliopterygini	(NE) <i>Scoliopteryx</i> Germ.

TABLE 2

NOCTUID QUADRIFID TRIBES AS IN FORBES' SYSTEM
(Showing genera named by Forbes found in Eremic Zone)

ERASTRIINAE	
Eublemmini	(NE) <i>Eublemma</i> Hübner
	(NE) <i>Ozarba</i> Walker
Erastrini	
Acontiini	(NE) <i>Acontia</i> Tr. = <i>Tarache</i> Hübner.
EREBINAE [OTHREINAE]	
Synedini [Drasteriini]	(NE) <i>Drasteria</i> Hübner
Anomini	(NE) <i>Anomis</i> Hübner
Scoliopterygini	(NE) <i>Scoliopteryx</i> Germar

in the Noctuidae-Quadrifinae eight tribes were named and diagnosed, summarised in Table 1. C. Börner included the *Jaspidiinae* (= *Erastrinae*) with the Trifid-Noctuidae, and combined the three genera *Erastria* Ochs. (in which he seems to include *Porphyria* Hübner, *Jaspidia* Hübner, and *Unca* Oken). *Emmelia* Hübner, and *Acontia* Ochs. in a proposed tribe *Mamestrini* together with such genera as *Mania* Treitschke, *Hydroecia* Guenee, and *Hadena* Schranck. To most students of the Noctuidae, this tribe seems unnatural and too inclusive; one is not surprised therefore that C. Boursin (1947:65-78) summarising Börner's system and praising some of its good points on p. 66 ibidem disassoci-

ated himself from its conclusions. C. Boursin was well aware of the unsatisfactory aspects of the Hampsonian system, but he did not find Börner's system, for the Noctuidae, a satisfactory substitute. In particular Börner placed *Autophila* Hübner in the *Toxocampini* whereas Boursin removed it to the neighbourhood of *Pyrois* Hübner in the *Zenobiinae*; on this particular point there may be many who would agree with Börner, and retain the Hampsonian position of *Autophila* and the related genera which Boursin transferred to the Trifid-Noctuidae. Some species of the genera mentioned by Börner in tribes shown in Table 1 may be found here and there on untypical habitats

in the Eremic Zone, but *Autophila* is the only genus containing one or two Eremic species; but not enough to make it an Eremic genus. I propose to replace *Cocytini* Börner by *Anuini* (see Table 3), to avoid confusion with the Sphingid genus *Cocytius* Hübner. Moreover, *Cocytini* Börner contained two genera placed in widely different tribes in Table 3.

Forbes (1954) dealing with a New World fauna proposed a few tribes, only embracing a small part of the Noctuidae-Quadrifinae which he catalogued. He termed his other groupings "series" or "groups", and evidently did not consider them equivalent to tribes.

Table 2 summarises Forbes' tribes that are relevant to this article; purely New World Tribes, such as *Erebini*, are omitted. Forbes' treatment of the *Erastrinae* is more traditional than that of Börner, and will probably be preferred since the tribes are smaller and less heterogeneous. They are based mainly on tympanum characters. His name *Synedini* is questionable, and it seems strange that he used it while sinking *Syneda* Guenée to *Drasteria* Hübner. Those of his tribes which are considered here are either Holarctic (e.g. *Synedini*) or Holotropical (e.g. *Anomini*); the former contains a minority of Eremic specialists. Out-

TABLE 3

BERIO'S 1959 SYSTEM OF "PHYLA" AND GENERA, WITH PROPOSED TRIBAL NAMES AND TYPE-GENERA

"Phylum of Cerocala"Type genus: (NE) *Cerocala* Boisd, 1829(NE) *Leucanitis* Guenee, 1852(NE) *Aleucanitis* Warren, 1913(E) *Gnamptonyx* Hampson, 1894³

"Phylum of Anua"

Type genus: (NE) *Anua* Walker.(E) *Clytie* Hübner, 1823¹(NE) *Ophiusa* Ochs.

and 7 other genera, all NE.

"Phylum of Scodionyx"

Type genus: (E) *Scodionyx* Staudinger, 1899

"Phylum of Pericyma"

Type genus: (E) *Pericyma* H. Schaeff., 1845.(NE) *Heteropalpia* Berio, 1938(NE) *Cortyta* Walker, 1857²(NE) *Tytroca* Wiltshire, 1970(E) *Gnamptonyx* Hampson, 1894³

"Phylum of Achaea"

Type genus: (NE) *Achaea* Hübner, 1823(NE) *Prodotis* John, 1910(NE) *Grammodes* Guenee, 1823(NE) *Dysgonia* Hübner, 1823

and five other NE genera.

(NE) *Drasteriini* nom. nov. for
Synedini Forbes, 1954.Type genus: *Drasteria* Hubn.(= *Leucanitis* Guenee plus
Aleucanitis Warren)(NE) *Anuini* nom. nov.Type genus: (NE) *Anua* Walker, 1858.(NE) *Scodionychini* nom. nov.(NE) *Pericymatini* nom. nov.*Achaeini* nom. nov.

¹ with which *Hypoglaucitis* Warren is identical (syn. nov.)² *Cortyta* was restricted to its type-species, the S. African *canescens* Walker in Wiltshire, 1970:101.³ *Gnamptonyx*, though placed with *Cerocala* by Berio was restored to its usual position, i.e. in the *Pericymatini*, in Wiltshire, 1970:102, for reasons given there.

side these tribes Forbes mentions a few genera containing single species which may penetrate the Eremic zone, e.g. the Holotropical *Tathorhynchus exsiccata* Lederer, related to the genus *Autophila* already mentioned.

Berio, 1959, in a study of the spining of the tibiae of the Old World *Catocalinae* and a few *Othreinae*, grouped certain genera into "Phyla". The International Code of Nomenclature, 1961, makes no recommendation for Phylum-names, and in most systems a Phylum is above the order, is not a genus-group. Therefore except where a prior tribe-name exists I propose that Berio's Phyla (morphologically diagnosed in Berio, 1959) be considered tribes, and the appropriate tribal suffix is shewn in Table 3, in accordance with ICZN Recommendation 29. Berio (personal communication to author, 1974) has agreed to this proposal. Table 3 omits those groups which are entirely non-Eremic, but a few NE genera are included in the table in cases where a few species penetrate the zone to a limited extent, e.g. in enclaves.

Some of the tribes in Tables 1, 2 and 3 will probably require modification, especially considering the different structural criteria used by the three authors, but this must be considered separately. The Eremic genus *Anydrophila* John, 1909, placed by Warren (1913) following *Cortytia* in the *Catocalinae*, was omitted by Berio; its position is discussed below. There is, too, a residue of genera in the *Othreinae* characteristic of the Eremic Zone and requiring tribal distinctions. Only after these definitions will a discussion of the distribution and probable history of the Eremic groups be possible.

Subfamily Catocalinae sensu Hampson

Tribe: *Anydrophilini* nom. nov.

Type-genus: *Anydrophila* John, 1909.

This genus hardly fits into the above tribes and I propose that it constitute its own mono-

typic tribe; at present ten species are known belonging to it—besides the five species in Warren 1913:340 there have been described four more in Brandt 1939, 268-69 and one in Wiltshire, 1947:2.

Characteristics of the genus are: Proboscis, present, strong. Frons, flat or prominent. Male antenna with long bundles of cilia. Mid-tibiae, with one row of scanty spines, other legs spineless; my examination of three Iranian species shows that Warren, 1913:340 is erroneous about the hind-tibiae. The male genitalia resemble generally those of many *Catocalinae* genera and would indicate a position between *Clytie* and *Scodionyx*: from *Clytie* they differ in the simpler uncus and symmetrical valves, in these regards resembling *Scodionyx*; in aedeagus form the genus resembles *Clytie* and *Scodionyx*; it differs from *Scodionyx* in habitus, antenna, and fore-leg, also in the uncus-form, and the junction of the valves above and below the aedeagus. Its distribution, from N. Africa to Central Asia, is typically Eremic, with an East Eremic concentration.

Sub-family Othreinae (= Nociuinae sensu Hampson)

Tribe: *Anumetini* nom. nov.

Type-genus: *Anumeta* Walker, 1858 (Syn.: *Palpangula* Staudinger)

The tribes' distinguishing characters are: Frons, smooth, flat; ♂ antenna, ciliated; fore-tibia with spines and terminal claws, other legs spineless. ♂ genitalia, symmetrical, with thickened, hairy, thorn-tipped uncus; normal tegumen; simple, elongated valves without processes or harpes, with setose costa and short narrow sacculus, and rounded tip; aedeagus, cylindrical, normal, vesica usually with a bent small chitinous plate; ♀ genitalia, little differentiated, with well-developed ovipositor lobes, weak ostium, usually sclerotised ductus bursae, and large oval bursa copulationis.

The three genera here standing are in fact synonymous; they are: *Anumeta* Walker, 1858, *Imitator* Alpheraky 1882, and *Eremonoma* Warren 1913.

Anumeta is distributed in deserts from N. Africa to India and Mongolia. *Imitator* (syn. n.), known only from the deserts of Central Asia, differs in having brachypterous females; this distinction does not in itself justify generic separation, other genera containing a minority of species with brachypterous females (e.g. *Agrotis* Ochs. see Warren 1913, Plate 5 c. "*Euxoa*" *fatidica* Hubn.). *Eremonoma* (syn. n.) found in deserts from N. Africa to the Persian Gulf, differs only in habitus.

Tribe: *Armadini* Wiltshire, 1961.

Type-genus: *Armada* Staudinger, 1885.

Other genera:

Metoponrhis Staudinger, 1888.

Epharmottomena John, 1909.

Drasteriodes Hampson, 1926.

Riadhia Wiltshire, 1961.

Metopistis Warren, 1913.

Acrobyla Rebel, 1903.

Asplenina Hampson, 1916.

Tarachephia Hampson, 1926.

Forty-one species, including three undescribed, belong to the above nine genera and a tenth undescribed one. A revision of the tribe is in preparation; it is distinguished from its neighbours by the domed or more angular frontal prominence, the very diverse fore-wing habitus, and the short feet with unspined tibiae, with the exception of one species with a small terminal dart on the fore-tibia. The ♂ genitalia are characterised by the normal tegumen, transtilla and juxta; the valves, either symmetrical or larger or more decorated on the left side, opening easily when mounted in ventral position, as in most Trifid genera of the Noctuidae, varying in a series from simple, and sub-oval, to more elongated

and sclerotised, with costal and medial-ventral processes as well as harpes; the aedeagus is normal, usually curved dorsoventrally, and sometimes slightly scobinated or otherwise developed distally; cornuti may be absent or numerous, but are never long; and some groups have well developed black pigmented coremata invaginated in the eighth ventrite. The ♀ genitalia have sclerotised antrum and ductus bursae; the bursa copulationis may be sclerotised and rather compressed, or large and membranous, often with a large membranous appendix.

The distribution of these forty-one species is mainly Eremic, with an Eastern Eremic concentration; nearly half the total are Iranian-Turanian and very localised; in three genera there are one widespread Saharan-Sindian species as well as other more local desert species; one monotypic genus (*Asplenina*) extends from Arabia to South Africa; and a few species are found in tropical or temperate steppe mountains on the fringes of the true desert.

The following monotypic Eremic genera are placed near *Anumeta* and *Armada* by Warren 1913; as regards their tribal affinities, they appear *incertae sedis*:-

Genus: *Marsipophora* John, 1909.

Fits into neither *Anumetini* nor *Armadini*; frons, smooth and flat; fore-tibia with a large terminal claw; habitus of fore-wing recalling *Calophasia*; hind-wing cell with a large black spot; its ♂ genitalia are symmetrical and of general *Armadini* type without agreeing with any *Armadini* genus. Distribution: Iran, Transcaspia (= "Iranian-Turanian"), deserts.

Genus: *Teinoptera* Calberla 1891

This genus and species are a mystery. The type of *T. culminifera* calb. is inaccessible or lost, and the species has apparently never been recaptured since description, despite subsequent visits by lepidopterists to its place of capture (El-Arish desert) (Sinai or near by).

SUMMARY OF CATOCALINAE *sensu lato* OF EREMIC ZONE

The Eremic genera detailed above comprise 101 species belonging to 17 genera and 6 tribes; of the latter, three tribes (*Scodionychini*, *Anuini*, *Pericymatini*) are Palaeotropical, and three are Eremic (*Anydrophilini*, *Anumetini*, *Armadini*); in addition two monotypic genera (*Marsipiophora* and *Teinoptera*) of uncertain tribal affinity are purely Eremic.

Of the Eremic genera, the two most numerous in species are *Anumeta* (with 24 species, or 21 before the synonymies proposed above) and *Clytie* (with 19 species); four Eremic genera are monotypic: *Scodionyx*, *Riadhia*, *Marsipiophora*, and *Teinoptera*; *Gnamptonyx* and *Metopistis* have only two species, so had *Pericyma* before the combinations proposed in Wiltshire 1970.

In the same sub-family, Catocalinae *sensu lato*, there are, of course, non-Eremic genera containing a minority of Eremic species, and in some of the following the minority is sizeable:- *Heteropalpia*, *Tytroca*, *Drasteria* and *Cerocala*. Three of these could have been classed as Eremic had we included the isolated S.W. African deserts in our definition, as could the monotypic genus *Asplenla*. Other non-Eremic genera with fewer Eremic species are *Thria* Walker, *Acantholipes* Lederer, *Thermesia* Hübner, and *Autophila* Hübner (sec. Boursin, a Trifid); this short list omits genera in which a few species only inhabit oases in the Eremic zone, and none the actual desert.

DISCUSSION

None of the Eremic genera here considered belong to a Palaearctic or Holarctic tribe, as against three belonging to Paleotropical tribes; but before concluding that the Eremic fauna

cannot have had Angaran or Cool-temperate origins, it must be recalled that in selecting for treatment in this article only Quardifine Noctuidae we have selected a group more prevalent in the Tropics; an analysis of the Eremic Trifid Noctuidae might well redress the balance, at least to some extent.

Stenophagy (oligophagy) is marked in some groups of Eremic Noctuid genera; but too little is known of the life histories of the majority to permit conclusions to be drawn; probably stenophagy and euryphagy are to be found in similar proportions in the desert fauna as in other Lepidopterous faunae.

Clytie, a very typically Eremic genus, is, as far as is known, monophagous on *Tamarix*, a tree or shrub usually found in oases of the deserts and steppe zones, outside which it is found typically on the coasts of the Temperate Zone: thus the one non-Eremic *Clytie* species, *C. illunaris*, is found on the tamarisks of South France and other Mediterranean countries; but the genus is overwhelmingly Eremic, with East Eremic predominance; it ranges from the extreme west to the extreme East of the desert zone, and very little outside it. The *Anuini* in which Berio placed it however has a majority of Tropical genera.

The bushes and trees of the genus *Acacia* are another food-plant on which Eremic lepidoptera are stenophagous, as discussed for several families in Wiltshire 1949:449-452. In this case the foodplant itself indicates a Paleotropical origin, confirming the evidence provided by co-tribal or congeneric relatives; for the genera *Heteropalpia* and *Tytroca* extend through Tropical Africa into S. Africa; the foot-hold of the *Acacia*-feeding desert-moths is more restricted and southerly than that of *Clytie* in the Eremic zone, as this foodplant does not tolerate the cold of the Central Asian deserts; however, the dwarf leguminous bushes

Prosopis and *Alhagi* provide a substitute for the related genus *Pericyma* which ranges from the East Mediterranean to the Transcaspian deserts and Central Asian steppes; *Gnamptonyx* and *Scodionyx* are two further apparently monophagous genera attached to *Acacia*. *Scodionyx* is placed by Berio in a tribe with the decidedly African genus *Acanthonyx* Hampson of whose biology little is known.

The genus *Cerocala* is also, as far as is known, monophagous on the genus *Helianthemum* (see Wiltshire 1962b for the life-history of *C. sana* Stgr.: the West Mediterranean species *C. scapulosa* Hübner feeds on *H. halimifolium*, while *C. sana* feeds on the desert dwarf shrubs *H. kahiricum* and *lippii*). This genus is mainly Tropical African and information is lacking of its foodplants there.

Apart from the above and a few other miscellaneous desert moths whose early stages were also described in Wiltshire 1962b, the food-plant of most Eremic lepidoptera is unknown. This particularly applies to the *Anydrophilini*, *Anumetini* and *Armadini*. These tribes have the same distribution-pattern, i.e. Pan-Eremic with an East Eremic or Iranian-Turanian concentration, suggesting that Transcaspia and Iran are the main centres of origin of the Eremic fauna. In the *Armadini* alone a few Palearctic species, with comparatively undeveloped morphology, suggest that prior to the great outburst of Eremic specialisation, whether speciation or generic evolution, the tribal ancestors were Afro-Indian ("Gondawana-land"), but as the affinity of some of these primitive forms is perhaps debatable, this is no more than a suggestion; it should be noted however that these Eremic genera and tribes have no links with New World groups at all.

The high taxonomic level of Eremic specialisation in the groups under consideration (going higher than generic level in about fifty per

cent of the cases) would indicate a very ancient association of moths with desert habitat: the North Tropical deserts, one can infer, have subsisted, occupying a greater or lesser expanse, over a very long geological period, doubtless over the whole Tertiary and Quaternary periods; the localisation of most of the species, and the comparative fewness of the very widespread species, i.e. those with "Saharan-Sindian" range (e.g. *Acrobyla kneuckeri* Rebel) and "Pan-Eremic" range [e.g. *Armada panaceorum* (Men.)] may be evidence of a previous fragmentation of the desert zone caused by pluvial or even glacial periods on one or more than one occasion during this long time. The widespread species will thus probably have reached their present westernmost limits (that is the Western Sahara) only after that desert's last pluvial period, whereas the few West Eremic species (e.g. *Metoponrhis rungsi* Luc. and *Anydrophila sabouraudi* Luc.) and the Mediterranean *Clytie illunaris* owe their isolation and independence to earlier speciation, perhaps resulting from a previous pluvial period, and are derived from common Eremic ancestors which migrated westwards from the Asiatic centre of distribution much earlier, during a Tertiary dry period.

SUMMARY

Systematic

In the Noctuidae (Quadrifinae) a few names of tribes were proposed by Börner (1939 & 1944) and Forbes (1954); the "Phyla" of Berio (1959) are in fact tribes and suitably terminated names are proposed for them. Even then, available names do not exist to cover all the Catocalinae (*sensu lato*); three new tribes in this subfamily are therefore diagnosed and proposed:- *Anydrophilini*, *Anu-*

metini, and *Armadini*. The first two are exclusively, the third predominantly Eremic. The Eremic genera *Marsipiophora* John and *Teinoptera* Calberla remain tribally *incertae sedis*.

Zoogeographic

Disregarding non-Eremic genera, which may of course contain Eremic species, the Catocalinae *sensu lato* contain 17 Eremic genera and 101 Eremic species; these fall into six tribes, three of which are Paleo-Tropical, three Eremic. Stenophagy of *Clytie* on *Tamarix*, of *Heteropalpia*, *Tyroca* and *Gnamptonyx* on *Acacia*, and of *Cerocala* on *Helianthemum*, has been observed: other Eremic genera however may be euryphagous. A very ancient as-

sociation of moths with desert habitat is deduced from the high taxonomic level of the Eremic specialisation in these Noctuidae. It is suggested that the North Tropical Old-World deserts have subsisted throughout the Tertiary and Quaternary. The most widespread Eremic species probably reached their present Western limits in N.W. Africa after the last Saharan pluvial period, expanding from a S.W. Asian centre; the small West Eremic category may have immigrated from a similar centre earlier, perhaps in the late Tertiary, and have speciated when isolated by pluvial periods. In the subfamily considered the remoter origin for the Eremic groups appears Tropical (Gondwanaland) rather than Temperate (Angaran).

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